XVI. *Deſcription of a new Electrical Inſtrument capable of collecting together a diffuſed or little condenſed Quantity of Electricity.* *By Mr.* Tiberius Cavallo, *F. R. S.*

Read April 10, 1788.

ONE of the principal deſiderata in practical electricity has been a method of aſcertaining the preſence and quality of ſuch diffuſed or weak electricity as could not immediately affect an electrometer; of this nature is the electricity produced by effervescences and other proceſſes, the electricity of the atmoſphere in ſerene and warm weather, &c.

M. Volta's condenſer, which is deſcribed in Volume LXXII. of the Philoſophical Tranſactions, was the firſt attempt of the kind, and, indeed, when this inſtrument is in good order, it anſwers exceedingly well; but the difficulty of conſtructing and of preſerving it, added to the frequent uncertainty of the reſult (it being difficult to ſay, whether in certain caſes the electricity obtained comes from the inſtrument itſelf, or from the ſubſtance in queſtion) have occaſioned its being little, if at all, uſed by thoſe who ſtudy the ſubject of electricity.

Mr. Bennet's doubler, which is deſcribed in Volume LXXVII. of the Philoſophical Tranſactions, was alſo intended to manifeſt ſmall, and otherwiſe unperceivable, quantities of electricity; but from the experiments and obſervations, which I had the honour of laying before the Royal Society in November laſt, it ſeems to be clearly ſhewn, that this doubler

bler cannot be of any uſe, on account of its being naturally always electrified.

In the ſame Paper of laſt November, I likewiſe ſhortly mentioned a method which I had uſed for collecting diffuſed quantities of electricity. Since that time, I have improved the method; and, after ſeveral alterations, have conſtructed an inſtrument for the purpoſe, which, to all my friends who are converſant in electricity, as well as to myſelf, ſeems to be free from all thoſe faults which render M. VOLTA's and Mr. BENNET's inſtruments of little, if at all of any uſe. It ſeems, therefore, that the following deſcription of this new inſtrument may be of uſe to thoſe who are purſuing electrical experiments and inveſtigations.

The properties of this machine, which from its office may be called *a collector of electricity*, are, firſt, that when connected with the atmoſphere, the rain, or in ſhort with any body which produces electricity ſlowly, or which contains that power in a very rarefied manner, it collects the electricity, and afterwards renders both the preſence and quality of it manifeſt, by communicating it to an electrometer. Secondly, This collecting power, by increaſing the ſize of the inſtrument, and eſpecially by uſing a ſecond or ſmaller inſtrument of the like ſort to collect the electricity from the former, may be augmented to any degree. Thirdly, It is conſtructed, managed, and preſerved with eaſe and certainty; and it never gives, nor can it give, an equivocal reſult, as I have proved experimentally, and as will appear by conſidering its conſtruction.

The annexed drawing exhibits two perſpective views of this collector. Fig. 1. (Tab. IV.) ſhews the inſtrument in the ſtate of collecting the electricity; and fig. 2. ſhews it in the ſtate in which the collected electricity is to be rendered manifeſt. An

electrometer

electrometer is annexed to each. The letters of reference indicate the ſame parts in both figures.

ABCD is a flat tin plate, thirteen inches long and eight inches broad; to the two ſhorter ſides of which are ſoldered two tin tubes AD and BC, which are open at both ends. DE and CF are two glaſs ſticks covered with ſealing wax by means of heat, and not by diſſolving the ſealing wax in ſpirits. They are cemented into the lower apertures of the tin tubes, and alſo in the wooden bottom of the frame or machine at E and F, ſo that the tin plate ABCD is ſupported by thoſe glaſs ſticks in a vertical poſition, and is exceedingly well inſulated. GHILKM and NOPV are two frames of wood, which being faſtened to the bottom boards, by means of braſs hinges, may be placed ſo as to ſtand in an upright poſition and parallel to the tin plate, as ſhewn in fig. 1. or they may be opened, and laid upon the table which ſupports the inſtrument, as ſhewn in fig. 2. The inward ſurfaces of thoſe frames from their middle upwards is covered with gilt paper XY; but it would be better to cover them with tin plates, hammered very flat. When the lateral frames ſtand ſtraight up, they do not touch the tin plate; but they ſtand at about one-fifth part of an inch aſunder. They are alſo a little ſhorter than the tin plate, in order that they might not touch the tin tubes AD, BC. In the middle of the upper part of each lateral frame is a ſmall flat piece of wood S and T, with a braſs hook; the uſe of which is to hold up the frames without the danger of their falling down when not required, and at the ſame time it prevents their coming nearer to the tin plate than the proper limit. It is evident, that when the inſtrument ſtands as ſhewn in fig. 1. the gilt ſurface of the paper XY, which covers the inſide of the lateral frames, ſtands contiguous and parallel to the tin plate.

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When the inſtrument is to be uſed, it muſt be placed upon a table, a window, or other convenient ſupport, a bottle electrometer is placed near it, and is connected, by means of a wire, with one of the tin tubes AD, BC; and by another conducting communication the tin plate muſt be connected with the electrified ſubſtance, the electricity of which is required to be collected on the plate ABCD: thus, for inſtance, if it be required to collect the electricity of the rain, or of the air, the inſtrument being placed near a window, a long wire muſt be put with one extremity into the aperture A or B of one of the tin tubes, and with the other extremity projecting out of the window. If it be required to collect the electricity produced by evaporation, a ſmall tin pan, having a wire or foot of about ſix inches in length, muſt be put upon one of the tin tubes, ſo that the wire going into the tube the pan may ſtand about two or three inches above the inſtrument. A lighted coal is then put into the pan, and a few drops of water poured upon it will produce the deſired effect. Thus far may ſuffice with reſpect to the mechanical deſcription of the inſtrument: the power and uſe of it will be made apparent by the following experiments.

EXP. 1. Communicate to the tin plate ABCD a quantity of electricity, for inſtance, as much as would very ſenſibly affect a common cork-ball electrometer; then, if the lateral frames GHM, NOP, ſtand upright, as in fig. 1. the electrometer W will ſhew no divergency; but if the frames are opened and let down, as in fig. 2. the balls of the electrometer W will immediately repel each other, and by the approach of an excited piece of ſealing-wax, the quality of the electricity may be eaſily aſcertained after the uſual manner.—Put up the lateral frames again, and the electricity will apparently vaniſh;—let them down, and the electricity will re-appear, and ſo on.

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If you touch any part of the tin plate or tin tubes with your finger, the electricity is thereby intirely removed, and that will be the caſe whether the lateral frames are up or down.

Exp. II. Take an extended piece of tinfoil, about four yards ſquare, and, holding it by a ſilk thread, electrify it ſo weakly as not to be capable of affecting an electrometer; then bring it in contact with the tin plate of the collector, whilſt the lateral frames are up. This done, remove the tin-foil, let down the lateral frames one after the other, and on doing this, the electrometer W will immediately manifeſt a conſiderable degree of electricity. But if the electrometer were to ſhew no ſenſible degree of electricity, a ſmaller collector, *viz.* one having a tin plate of about four ſquare inches, muſt be brought into contact with the tin plate of the large collector, whilſt the lateral frames of the latter only are down; and then the ſmall collector being removed from the large one, its lateral frames are opened, and its tin plate is preſented to an electrometer, which will thereby be electrified to a much greater degree than the electrometer W was by the large collector.

Exp. III. Let a common cork-ball electrometer be faſtened to an inſulated conductor, having about two or three ſquare feet of ſurface, and communicate to it ſuch a quantity of electricity as may be ſufficient to let the balls of the electrometer ſtand at about one inch aſunder. In this ſtate bring the conductor in contact with the tin plate of the collector for a very ſhort time, and it will be found, that the balls of its electrometer will immediately approach and touch each other, ſhewing that the electricity of the conductor is gone to the plate of the collector; and, in fact, if you let down the lateral frames, the balls of the electrometer W will immediately repel each other to a very great degree.

It ſeems, therefore, to be clearly ſhewn by theſe experiments, that the tin plate of this inſtrument can collect and retain a vaſt quantity of electricity, when the conducting ſurfaces of the lateral frames are contiguous to it, in compariſon to that quantity which it can either collect or retain when thoſe ſurfaces are removed from its vicinity.

The quantity of electricity, which the tin plate ABCD is capable of collecting, principally depends on three circumſtances, *viz.* 1ſt, on the diſtance between the tin plate and the conducting lateral ſurfaces; the ſmaller that diſtance is, the greater being the collecting power; 2dly, on the ſize of the inſtrument; and, 3dly, on the quantity of electricity poſſeſſed by the body from which it muſt be collected or taken away.

I need not expatiate on the principle upon which the action of this inſtrument depends; this being the ſame as that of the electrophorus, of M. VOLTA's condenſer, and of many other electrical experiments; namely, that a body has a much greater capacity for holding electricity when its ſurface is contiguous to a conductor which can eaſily acquire the contrary electricity, than when it ſtands not in that ſituation.

I ſhall laſtly add, that having actually uſed this new inſtrument in ſeveral experiments, I have found it to anſwer perfectly well; one of its principal recommendations being the certainty of its operation.